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NEOTROPICAL RAPTORS AND DEFORESTATION: NOTES ON DIURNAL RAPTORS AT FINCA EL FARO, QUETZALTENANGO, GUATEMALA

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ABSTRACT.—Twenty-one species of diurnal raptors (Family Cathartidae, Pandionidae, Acciptridae and Falconidae) are reported from Finca El Faro, Quetzaltenango, Guatemala. Observations were made from 1 March 1987 through 5 March 1989. Data are also included for an additional eleven species of diurnal raptors whose presence is suspected. Comparisons with known diurnal raptor components of 4 well-studied Central American parks and reserves are presented.

Our current knowledge of ecological requirements of tropical raptors is poor (Newton 1979; Thiollay 1985a). A recent summary of data available on tropical forest raptors suggests a dearth of basic natural history data for most species (Thiollay 1985a).

In particular studies on diurnal raptors of the Neotropics are lacking. A review of recent literature (e.g., Burton 1983) suggests that older references continue to be cannibalized (Dickey and van Rossem 1938; Blake 1953; Slud 1964; Wetmore 1965; Smithe 1966; Brown and Amadon 1968; Monroe 1968; Land 1970; Meyer de Schauensee 1970; Alvarez del Toro 1971). While recent publications on the region's avifauna have added minor ecological notes and distributional data (Ridgely 1976; Blake 1977; Parker et al. 1982; Hilty and Brown 1986), few comprehensive studies have been made. Notable exceptions deal with reproductive biology of more spectacular species (Harrison and Kiff 1977; Rettig 1978; Bierregaard 1984; Lyon and Kuhnigk 1985; Jenny and Cade 1986). While publications dealing with diurnal raptors of the Indo-australian region have provided us with insight into the habits of these birds (Hollands 1984; Coates 1985), raptors of the Neotropics remain largely neglected.

Guatemala's avifauna is among the better studied in Central America (Salvin and Godman 1897-1904; Griscom 1932; Smithe 1966; Land 1970; Vannini, unpubl. ms.). The known avifaunal component totals 714 species (Vannini, unpubl. ms.). Diurnal raptors comprise 49 species or 6.86% of the country's

total avifauna. This percentage relationship is the highest for a political region in the northern and middle Neotropics (this study). Guatemala's diurnal raptors include 6 migrant taxa which spend varying periods of time in the Nearctic region; 35 resident species and 8 species with migrant and resident populations (Land 1970; Vannini, unpubl. ms.).

Finca El Faro is a privately owned plantation on Guatemala's Pacific versant (Fig. 1), owned and managed by Agroindustrias Tamer, S.A. The plantation has been the focus of a joint research project since 1 March 1987 between the Fundación Interamericana de Investigación Tropical (FIIT) and the University of Texas at Arlington (UTA). During the course of floral and faunal inventories a number of observations were made on the diurnal raptors of this reserve.

This paper summarizes the data collected during the course of these inventories and compares the known diurnal raptor fauna of Finca El Faro with other well-studied parks and reserves in the northern Neotropics in an attempt to demonstrate that plantation areas are utilized by a wide range of native and migrant raptors, and may provide valuable "buffer" areas when adjacent to native forest.

STUDY SITE AND METHODS

Finca El Faro is a 670 ha subtropical plantation located on the south-western slopes of Volcanes Santa Maria and Santiaguito, in the department of Quetzaltenango, Guatemala. Elevations within the farm range from ca. 800-2500 m. Mean annual precipitation at 875 m elevation is

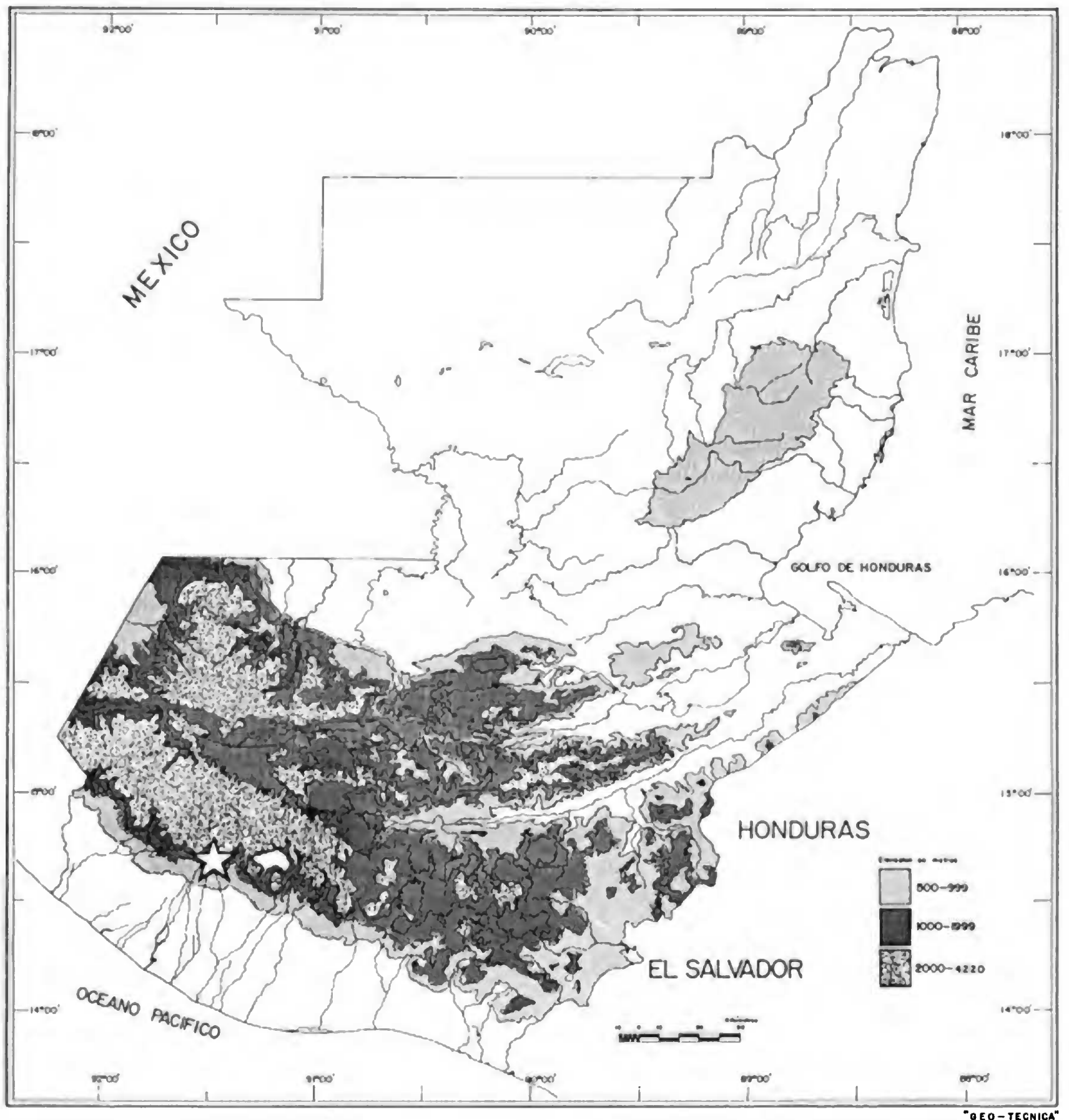


Figure 1. Hypsometric map of Guatemala and Belize showing the location of Finca El Faro (Star) in southwestern Guatemala.

ca. 4500 mm with peaks from late May-September (INSIVUMEH 1969). The site has been under continuous cultivation since the early 1930s and has been subjected to several devastating periods of volcanic activity since the 1902 eruption of Volcan Santa Maria (McBryde 1945). The most dramatic of these nuée eruptions occurred in November 1929 and 19 April 1973 (Rose, unpubl. ms.).

Presently, the site is being managed as a diversified plantation and premontane research facility. Land use

analysis shows ca. 220 ha under coffee (*Coffea arabica*), ca. 80 ha under cardamom (*Elettaria cardamomum*), ca. 40 ha under macadamia (*Macadamia integrifolia*) cultivation and ca. 330 ha as wildlife refuge area.

Conditions within the cultivated areas range from high density coffee plantings under heavily pruned *Inga* sp. shade through "climax plantation" cardamom under forest canopy with a considerable amount of native undergrowth. The area is rich in hydrological resources. Largest streams

on the farm are Rios Nima 1 and 2 which originate on the property above 2000 m elevation.

Vegetation in the wildlife refuge area dates primarily from April 1973 and is extremely dynamic. Although there are few trees which exceed 50 cm dbh, natural regeneration has been rapid. Conditions within this successional forest are comparable to those encountered in many mature premontane forests elsewhere along Guatemala's Pacific versant except tank bromeliads and orchids are rare (pers. obs.).

Data for this study were collected on weekends between 0500 and 1900 H from March 1987 through March 1989.

Road Surveys (adapted from Fuller and Mosher 1987). The farm has ca. 15 km of well-ballasted access roads at elevations from 800–1480 m on the east reserve entrance to ca. 1650 m on the west reserve entrance. Observations were made from various four wheel drive vehicles in the company of other observers. Vehicles were stopped only when raptors were observed and no standard speed was employed during the course of the study.

Foot Surveys (adapted from Fuller and Mosher 1987). In addition to use of vehicle access roads for foot surveys, the wildlife refuge area has 7.5 kms of stepped trails, 2 m wide which were used for surveys. Elevations on the trail range from 1480–2200 m (range = 720 m). Although steep in sections, visibility from the trail is generally excellent. Artificial light gaps have been cut in order to increase visibility and to create edge within the forest. Observations were made while walking the trail or standing at light gaps in the company of other observers. No standard speed was employed during the course of the study.

Mist Nets (adapted from Karr 1979). Three primary mist net stations have been established for avian and chiropteran inventories, located at 875 m (plantation); 1100 m (plantation/riparian forest) and 1450 m (premontane forest edge). Nets are generally used in pairs and range from 5–19 m in length and have 3–4 trammels. Nets are set at heights varying from ground level to 8 m and are supervised by a minimum of 2 observers. Although mist nets resulted in only 2 diurnal raptor captures from January–June 1988, the presence of vocalizing birds in mist nets or in hand attracted raptors to within close range on many occasions.

Observations were made using Bushnell 10 × 40 binoculars, Swift 10 × 44 binoculars, Jason 7 × 50 binoculars and a Celestron 100–200× spotting scope anchored on any convenient perch. Photographic records of individual diurnal raptors and intraspecific/interspecific interaction were made whenever feasible with Canon A1 and AE1 35mm cameras with lenses ranging from 28–500 mm.

Identification procedures at Finca El Faro require: voucher specimens in the case of plants and lower vertebrates; unmistakable photographic identification or multiple confirmations by reliable fieldworkers familiar with the taxon in question for birds and medium to large mammals (see Acknowledgments).

SPECIES ACCOUNTS

Turkey Vulture (*Cathartes aura*)

Turkey Vultures are common throughout the year at all elevations within the farm. Although generally

not as common as *Coragyps*, during October–November when migrants are present, Turkey Vultures may be observed in considerable numbers above 1100 m elevation. Both adult and juvenile birds have been recorded.

Black Vulture (*Coragyps atratus*)

Black Vultures are the most commonly observed diurnal raptor at Faro during all periods except October–November. Although observed at all elevations within the farm, Black Vultures are most common at elevations below 1450 m. Due to limited refuse availability, this species has not become a problem scavenger as at other parks and reserves in Central America (Burnham et al. 1988; pers. obs.)

Osprey (*Pandion haliaetus*)

A single juvenile Osprey was observed on 14 February 1988 at 875 m elevation flying eastward ca. 10 m overhead. No other observations of this species have been made and Osprey are obviously rare transients at Faro. Several coastal avian species frequently are observed at higher elevations along the volcanic chain (Land 1970; pers. obs.).

Cooper's Hawk (*Accipiter cooperi*)

Cooper's Hawks have been observed on 4 occasions at Faro at elevations ranging from 1100–1600 m. On 14 November 1987 a juvenile was observed in company with a mixed flock of migrating and resident raptors. On 12 March 1988 an adult female was observed soaring over gallery forest at 1100 m. On 8 May 1988 a poorly moulted adult was observed soaring over an area with newly planted coffee and on 13 November 1988 an adult was observed soaring over premontane forest edge. Cooper's Hawks are rare migrants in Guatemala, and observations during this study represent the first confirmations of this species' presence in the western highlands.

Sharp-shinned Hawk (*A. striatus*)

A migrant species. Sharp-shinned Hawks are commonly observed at Faro at elevations ranging from 1100–1600 m from January–April. Two adult females were mist-netted during March 1988. Pursuit and capture of Swainson's Thrush (*Catharus ustulatus*) has been observed, and collected prey remains have included doves (*Leptotila* sp.). During periods of heavy *Inga* sp. and *Cecropia* sp. flowering in February, up to 3 adult Sharp-shinned Hawks

have been observed aggressively defending small territories (<3 ha) containing high densities of native and migrant passerines.

Zone-tailed Hawk (*Buteo albonotatus*)

Zone-tailed Hawks are frequently observed throughout the year at Faro from ca. 900–1200 m elevation. At least 1 adult pair is resident in the area and single adults are observed daily during the dry season (January–May). An adult was observed to maintain a foraging territory during February–March 1988. Prey were primarily Basilisks (*Basiliscus vittatus*) and Ameivas (*Ameiva undulata*). Captures were effected by soaring over recently planted coffee and stooping from an altitude of 50 m. Success rate during brief observations appeared to be ca. 25% and observations during this study represent the first confirmation of this species' presence in the western highlands.

Short-tailed Hawk (*B. brachyurus*)

This small hawk is common throughout the year at elevations ranging from ca. 800–1700 m. At least 2 pair, and possibly a third, are believed to nest in the area. Three color morphs; white-chested, grey-chested and uniformly dark birds were observed. Courtship flights occurred from February–April 1988. Three Short-tailed Hawks were observed soaring at ca. 1500 m elevations on different dates in May 1988 and may have represented a breeding pair with the fledgling(s). An immature bird was observed perched and eating a lizard at 1550 m on 5 March 1989. Reported observations represent the first confirmation of this species on Guatemala's Pacific versant.

Red-tailed Hawk (*B. jamaicensis*)

Red-tailed Hawks are infrequently observed throughout the year on Faro at elevations ranging from ca. 1100–2200 m. During January 1988 a pair was observed displaying over grasslands and pine forests of upper Volcan Santa Maria. No juveniles have been observed. Red-tailed Hawks are normally restricted to open areas on Faro and appear to reach lower elevations via the Santiaguito/Rio Nima 2 corridor, thus avoiding the belt of premontane forest between 1500–2200 m. However, on 18 February 1989 a uniformly dark Red-tailed Hawk was observed soaring over premontane forest canopy at 1750 m.

Roadside Hawk (*B. magnirostris*)

Surprisingly, Roadside Hawks are uncommon on Faro. Although year-round residents and breeding birds occur in the area, encounters are infrequent. Juvenile and adult birds have been observed at elevations ranging from 875–1100 m. I hypothesize that diversity of habitats on Faro, in addition to competition from other small raptors, does not favor high Roadside Hawk populations. In sugarcane (*Saccharum officinalum*) fields within 15 km airline of Faro the species utilizes power poles as perches and is present at high densities where there is little or no competition from other similar-sized diurnal raptors (per. obs.).

Grey Hawk (*B. nitidus*)

Grey Hawks are abundant raptors at Faro at elevations ranging from ca. 800–1500 m. Several adult pairs are conspicuous throughout the year. Soaring aggregations of up to 4 birds have been observed and aggressive interactions between individuals over territories are frequent. Grey Hawks are adaptable birds with catholic diets and may use several techniques to capture prey. In most cases the bird simply drops from a perch onto small vertebrates such as lizards and snakes. During March 1988 several unsuccessful attempts by an adult to capture feeding Green Parakeets (*Aratinga holochlora*) were observed. Prey capture technique was strongly reminiscent of that used by *Accipiter* spp. and were made by gliding at high speed under plantation canopy. Most often observed in open habitats on Faro, 1 pair is most regularly observed perched and hunting in mature, enclosed plantation.

Broad-winged Hawk (*B. platypterus*)

A single adult Broad-winged Hawk was observed on Faro at 875 m elevation 17 January 1988. The bird soared briefly over coffee plantation and moved slowly east. Commonly observed in the western highlands (Land 1970; pers. obs.), this migrant species may be more common at upper elevations than this single record would suggest.

Swainson's Hawk (*B. swainsoni*)

A migrant species. Small aggregations of Swainson's Hawks are frequently observed during migration (September–October and April–May). Individuals are uncommonly observed September–May. On several occasions in October–November 1987 I noted

single birds gliding eastward along the volcanic chain at approximately the elevation of the cone of Volcan Santa Maria (3772 m). Several birds were observed to drop rapidly to an altitude of 1200–1500 m in order to group with other Swainson's Hawks and migrating Turkey Vultures.

Solitary Eagle (*Harpyhaliaetus solitarius*)

On 2 occasions during January–February 1988, I briefly observed what I am certain were adult Solitary Eagles soaring at elevations from ca. 1000–1100 m. Subsequent observations by a field associate familiar with Solitary Eagles elsewhere confirmed the presence of at least 1 adult bird on Faro. A single observation on 23 June 1988 of a juvenile bird at ca. 1500 m elevation was made by a group of biologists from the University of Texas at Arlington. Likely, a pair of these eagles breeds on the upper forested slopes of Volcan Santa Maria or Volcan Zunil immediately to the east. Observations during this study represent the first confirmation of this species on Guatemala's Pacific versant.

White Hawk (*Leucopternis albicollis*)

A single White Hawk was observed soaring over the runway on Faro at 850 m elevation on 15 March 1987. Although conspicuous at a distance when sitting along forest edge, White Hawks may occur in mature plantation or forest without being observed for some time. Comments by agricultural laborers on the neighboring La Florida plantation lead me to believe that investigation there would reveal a pair of these birds.

Ornate Hawk-Eagle (*Spizaetus ornatus*)

A large adult female Ornate Hawk-Eagle was observed at close range on 19 July 1987. The bird was perched 15 m from the ground in a large *Cecropia* sp. at 1480 m elevation, exactly along the wildlife refuge area boundary. The bird called constantly for 5 min with crest raised, then soared slowly downhill over newly-planted coffee. Two additional observations were made in 1987; 1 of a much smaller bird flying over gallery forest and plantation along Faro's eastern border at ca. 1300 m elevation. No observations were made in 1988 or early 1989. I suspect that the birds breed further east on Volcan Santa Maria and visit Faro occasionally. Observations recorded during this study represent the first

confirmation of this species for the western highlands.

Tyrant Hawk-Eagle (*S. tyrannus*)

Tyrant Hawk-Eagles are commonly observed on Faro between ca. 800–3000 m. Aerial display flights by a resident pair were observed during March–April 1988. A complex courtship display flight involving contact and roll-overs was observed in the company of Peregrine Fund biologists on 18 February 1989 at ca. 2200 m. The pair is believed to nest on the reserve's lowest edge at 1400 m or just east of Faro. From February–June 1988, the adult male was observed soaring daily from 0900–1100 H. Vocalizations were made constantly while soaring and could be heard for several kms on clear days. On 27 February 1988 a juvenile female made a very close approach (<8 m) while I was removing a protesting Grey-cheeked Thrush (*Catharus minimus*) from a mist net in riparian forest at 1100 m elevation. The bird appeared from down a gorge, adjacent to a cardamom plantation and remained perched in a *Cecropia* sp. for ca. 15 min. The hawk-eagle appeared extremely interested in the thrush vocalizations, raising the crest and craning to obtain a better view when the thrush struggled in my hand, yet remarkably unconcerned over the excited conversation I was having with a field assistant. A juvenile Tyrant Hawk-Eagle, possibly the same individual, has since been observed close to the house at 875 m on several occasions from March–December 1988. Although no observations of hunting behaviour have been witnessed, Crested Guans (*Penelope purpurescens*) and Magpie-Jays (*Calocitta formosa*) have been observed to give alarm when a Tyrant Hawk-Eagle passes overhead. Observations reported in this study represent the first confirmation of this species' presence in the western highlands.

Bat Falcon (*Falco ruficularis*)

Individual female Bat Falcons have been observed on several occasions at 875 m elevation. On 17 June 1988, several biologists from the University of Texas at Arlington observed a bird at close range near the house. The Bat Falcon resulted in omnipresent flocks of Vaux's Swifts (*Chaetura vauxi*) and White-collared Swifts (*Streptoprocne zonaris*) "skying up," although no chases were observed. An adult female was observed hunting Vaux's Swifts during January 1989 by a field associate. Interestingly, several cap-

tive Bat Falcons are housed in a breeding chamber nearby. Although no interaction was witnessed, the presence of a vocal breeding pair may attract wild individuals. Bat Falcons are extremely rare on Guatemala's Pacific versant. Indiscriminate use of organochlorine pesticides may be affecting populations in certain areas (Cade 1982). Captive-bred Bat Falcons will be released at Faro during 1989.

American Kestrel (*F. sparverius*)

A migrant species; presence of resident subspecies suspected. Kestrels were frequently observed from October 1987 through April 1988 and appear to establish winter territories. At least 1 adult male was observed on 25 June 1988, suggesting that it may also be present as a resident. Kestrels favor newly planted coffee plantations and areas adjacent to Santiaguito at elevations from ca. 1100–1500 m but have not been seen in mature plantations or in the wildlife refuge area. As newer plantings mature, kestrels may ultimately be restricted to Rio Nima 2 drainage on Faro.

Laughing Falcon (*Herpetotheres cachinnans*)

A single Laughing Falcon was briefly observed on 14 November 1987 in an aggregation of soaring migrant and native raptors at ca. 1300 m elevation. An individual was observed 30 June 1988 perched in a dead tree near the plantation house at 875 m. Absence of a breeding population is surprising. Conditions on Faro favor Laughing Falcons, and common prey items such as medium-sized lizards and snakes are abundant (Campbell and Vannini 1988). Presently, the Laughing Falcon is considered a transient at El Faro.

Collared Forest-Falcon (*Micrastur semitorquatus*)

A resident Collared Forest-Falcon was heard calling from March–May 1987 and during April 1988 at ca. 1600 m in early evening. Although the bird responds to imitations of its call, this individual has not been seen. Prey remains found within 100 m of its preferred perch include White-faced Quail-Dove (*Geotrygon albifacies*) and Ruddy Quail-Dove (*Geotrygon montana*). Size of the doves and frequency of remains found at this perch suggest kills by the forest-falcon. A Collared Forest-Falcon was flushed in a mature macadamia orchard on 10 April 1988 at ca. 1000 m elevation. A large flock of Red-billed Pigeons (*Columba flavirostris*) flushed seconds later,

just below where the bird was perched. On 4 March 1989 at 1830 H an adult female was observed to fly over a river canyon at 1650 m and perch for ca. 15 min under canopy. The observations during the course of this study represent elevational records for the species in Guatemala.

Crested Caracara (*Polyborus planca*)

Caracaras are irregular transients at Faro throughout the year. Individuals have been observed at elevations from ca. 800–900 m, and occasionally an individual may take up residence for several days near the plantation house at 875 m. Caracaras frequently harass captive animals in the breeding project, and the species is very common at lower elevations within 10 km airline of Faro.

SPECIES WHICH POSSIBLY OCCUR AT FINCA EL FARO

King Vulture (*Sarcoramphus papa*)

Probable. King Vultures are rare or uncommonly observed on Guatemala's Pacific versant due to extensive deforestation and improved livestock management (Dickerman, unpubl. ms.; pers. obs.). Occasionally still observed near Siquinalá, Escuintla, the bird is probably a rare transient in western Guatemala.

Bicolored Hawk (*Accipiter bicolor*)

Probable. Bicolored Hawks are known from isolated locations on the Pacific versant (Griscom 1932) and range to elevations of 1350 m in Guatemala (Land 1970). A cryptic bird which does not vocalize frequently, acoustical luring or deep forest mist net stations may be required to confirm presence. On 5 March 1989 I briefly observed a medium-sized, white breasted *Accipiter* sp. at 1550 and 1700 m elevation. Suspected presence of a resident Sharp-shinned Hawk (*A. striatus chionogaster*) which is similar to pale morph Bicolored Hawks made a positive identification difficult.

Common Black Hawk (*Buteogallus anthracinus*)

Known from similar elevations and habitat within 15 km airline (Griscom 1932). Now rare on Guatemala's Pacific piedmont.

Marsh Hawk (*Circus cyaneus*)

Probable. Marsh Hawks are known from within 10 km airline at Quetzaltenango (Griscom 1932).

Presence as a migrant at elevations >2200 m in grassland almost certain.

White-tailed Kite (*Elanus caeruleus*)

Known from similar elevations and habitat within 15 km airline (Vannini, unpubl. ms.) and rapidly expanding its range in northern Central America.

Black Crane Hawk (*Geranospiza nigra*)

Rare or uncommon on Guatemala's Pacific versant and known from very few localities at upper elevations along the piedmont (Griscom 1932; Land 1970).

Double-toothed Kite (*Harpagus bidentatus*)

Probable. The species has only recently been confirmed as a resident of Guatemala's Pacific versant (pers. obs. with photo). An adult *Harpagus* was reportedly observed at close range on Faro in mature plantation during June 1987 (J. Darling, pers. comm.) but presence remains unconfirmed.

Grey-headed Kite (*Leptodon cayanensis*)

A lowland species in much of Guatemala. Known from 2 localities in the area; Finca El Carmen, 25 km airline from Faro (pers. obs.) and Mazatenango (P. Rockstroh, pers. comm. with specimen deposited at National Museum of Natural History). Both records are from mature plantation at somewhat lower elevations.

Merlin (*Falco columbarius*)

Known from very few records in Guatemala (Land 1970) but recorded at low and middle elevations along the Pacific versant as a migrant.

Orange-breasted Falcon (*F. deiroleucas*)

A remote possibility. A single specimen known from the Pacific versant of Guatemala is from Finca El Ciprés, a plantation on the southern slope of Volcan Zunil, 15 km airline from Faro at 600 m elevation (Griscom 1932). A large tract of pristine premontane and montane forest remains on the southern slope of Zunil and the eastern face of Volcan Santa Maria, although conditions described by Jenny and Cade (1986) as required for Orange-breasted Falcons have not been present for decades.

Peregrine Falcon (*F. peregrinus*)

Probable. Peregrines are now known to occur at a variety of elevations and habitats in Guatemala

(Land 1970; J. P. Jenny, pers. comm.; pers. obs.). Peregrines are infrequently seen in the western highlands, perhaps due to the presence of few observers. The Nima 2 river valley and Santiaguito's slopes provide suitable habitat and abundant quarry for migrant individuals.

INTERSPECIFIC INTERACTION OBSERVED IN DIURNAL RAPTORS AT FINCA EL FARO

- 1) *Cathartes aura*: mixed flocks of *C. aura*, *Coragyps atratus* and occasionally *Polyborus planca* have been observed. On 14 November 1987, an aggregation of *C. aura*, *C. atratus*, *Accipiter cooperi* (1), *Buteo nitidus* (1), *B. swainsoni* and *Herpetotheres cachinnans* (1) was observed at ca. 1300 m elevation at 0600 H. No aggression was noted.
- 2) *Coragyps atratus*: see *C. aura*.
- 3) *Accipiter cooperi*: see *C. aura*.
- 4) *Accipiter striatus*: on 6 March 1988 an adult *A. striatus* was observed to fly out of riparian forest at 1100 m elevation and harass a soaring juvenile *Spizaetus tyrannus*. Three initial stoops were made without contact. A fourth stoop resulted in a visible strike to the eagle's dorsum. The hawk-eagle commenced vocalizing and rolled to repel a fifth stoop before rapidly moving out of the area. Intraspecific aggression between similar sized *A. striatus* was commonly observed in February–March 1988.
- 5) *Buteo albonotatus*: on 14 February 1988 an adult *B. albonotatus* and an adult *B. jamaicensis* were observed soaring at similar altitudes at 1100 m elevation at 0930 H. After ca. 15 min of observation the *B. albonotatus* was observed to stoop the *B. jamaicensis*, which rolled and vocalized. The *B. jamaicensis* moved off upslope and disappeared from view while the *B. albonotatus* continued to forage.
- 6) *Buteo brachyurus*: commonly observed soaring in company with *B. nitidus* with no apparent interaction.
- 7) *Buteo magnirostris*: occasionally observed perched or soaring near *B. nitidus*. No aggression has been noted.
- 8) *Buteo nitidus*: see *C. aura*, *C. atratus*, *B. brachyurus* and *B. magnirostris*. *B. nitidus* are commonly observed adjacent to other soaring raptors with no signs of interest or aggression. Faro has high population densities and intraspecific

aggression among unpaired *B. nitidus* is intense. A climax plantation area at 1100 m is particularly subject to confrontations between a resident pair and intruders. Up to four birds were observed disputing this area on different dates during March 1988.

- 9) *Buteo swainsoni*: see *C. aura*.
- 10) *Spizaetus tyrannus*: see *A. striatus*.
- 11) *Herpetotheres cachinnans*: see *C. aura*.
- 12) *Polyborus planca*: see *C. aura*.

DISCUSSION

Thiollay (1985a) listed 37 Neotropical diurnal raptors which he considers tropical rainforest species. Four are identified as being associated with small clearings, edges, etc., and select niches are suggested for many of these "rainforest" species (Thiollay 1985b). Field observations of Neotropical raptors over a 13-yr period and comments by other researchers lead me to believe that groupings are largely artificial. Although there is no way of examining precolumbian habitat partitioning in Neotropical raptors, extensive use of "atypical" habitat (dry forests, plantations), in areas often adjacent or close to pristine tropical moist or wet forests infers a certain degree of adaptability to changes. I acknowledge that such may not be so for all taxa. Seven of the species identified as tropical rainforest indicator species by Thiollay occur on Finca El Faro in successional vegetation and varying types of plantation. I emphasize that much of the vegetation at Faro may be dated. Furthermore, a careful examination of regional works on Neotropical avifauna reveals a number of observations and collections made of these same species in degraded habitat (e.g., Wetmore 1965).

Finca El Faro has a known diurnal raptor fauna that includes 21 species. Ten species are resident which have been observed at different times during the course of this study; 5 species are infrequently observed transients; 5 are long-distance migrants which were observed from October to May, and 1 has both resident and migrant populations.

Faro provides a unique opportunity to study native vertebrates under a variety of conditions and elevations. Vegetational succession studies are being effected on both man-altered habitats and forest destroyed by the 1973 *nuée ardente* of Volcan Santiago. I am not aware of any studies made on diurnal raptors in the Neotropics along an elevational transect, or community studies in degraded habitat. Al-

though it has long been suspected that species such as *Buteo magnirostris*, *Elanus caeruleus* and *Falco rufigularis* are expanding their ranges parallel to the agricultural frontier (Land 1970; Cade 1982), observations presented in this study suggest that other diurnal raptor species may benefit from habitat transformation. Comparative studies at parks and reserves with similar elevations and biotas would be of considerable value (e.g., Parque Nacional Braulio Carrillo, Costa Rica).

A comparison of the avifauna and diurnal raptor faunas of 5 Central American parks and reserves and 6 political regions in the northern and middle Neotropics is presented in Tables 1-2. A clear relationship exists between the total known avifaunal component of Guatemala, Costa Rica and Panamá and the percentage composition of respective diurnal raptor faunas. Compared to these Middle American regions, Mexico (to the north), Colombia and Peru (to the south) have a significantly lower percentage of diurnal raptor species when compared to total known avifauna. It would be interesting to study the reasons behind the fact that Middle America possesses such statistically diverse diurnal raptor faunas.

Percentage relationships between the parks and reserves listed in Table 1 at lower elevations are closer than those of 2 premontane reserves (Faro/Monteverde). Interestingly, 2 factors commonly cited as being of primary importance for preservation of diversity in the Neotropics (i.e., size and latitude), do not appear to be of real importance (Willis 1974; Thiollay 1985a). Finca El Faro and Finca La Selva are the smallest reserves listed in this study, yet have the highest number of diurnal raptor species for their elevational groups (premontane and tropical, respectively) in addition to being rich in total avian diversity (Stiles 1977; Vannini 1989).

Clearly, factors other than size and latitude *must* be taken into account when discussing biodiversity potential in Central America. Although size of reserves is of undoubted importance throughout the Neotropics (Lovejoy et al. 1984), biogeography and elevation are of primary importance in Central America. Both El Faro and La Selva are located in regions of high vertebrate diversity, with corridors of mature vegetation connected to highlands. Importance of vegetational corridors in maintaining diverse biotas has only recently begun to be understood (Hartshorn 1983). Stiles (1985) studied local movements in hummingbirds (Family Trochilidae) and found that elevational migrations effected seasonally

Table 1. A comparison of diurnal raptor diversity in 5 Central American parks and reserves.

RESERVE	LOCATION	APPROX. AREA		ELEVATION	No. DIURNAL RAPTOR SPECIES CONFIRMED	HABITAT TYPES (HOLDRIDGE/TOSI)	TOTAL KNOWN AVIFAUNAL COMPONENT (TKAC)		DIURNAL RAPTOR FAUNA AS % OF TKAC
		LATI-TUDE	AREA (HA)				TKAC	TKAC	
Tikal National Park ¹	NE El Petén, Guate.	17°N	60 000	200-300 m	32	Tropical Dry Forest	314	10.17%	
Finca El Faro ²	Palmar, Quetz., Guate.	14.5°N	670	800-2600 m	21	Subtropical Moist Forest, Lower Montane Moist Forest	178	11.80%	
Monteverde ³	Cordillera Tilarán, C.R.	10°N	2 500	1200-1800 m	20	Tropical Premontane Moist Forest, Premontane Wet Forest, Tropical Lower Montane Wet Forest, Tropical Lower Montane Rain Forest, Tropical Premontane Rain Forest	236	8.47%	
Finca La Selva ⁴	Heredia, C.R.	10°N	1 350	40-130 m	36	Tropical Wet Forest, Tropical Premontane Wet Forest	389	9.25%	
Pipeline Road—Parque Soberania ⁵	Gamboia, Panamá	9°N	22 000	50-200 m	33	Tropical Wet Forest, Tropical Premontane Wet Forest	375	8.80%	

References: ¹ Smithe 1966; Burnham et al. 1988; ² Vannini 1989; ³ Powell 1977; ⁴ Stiles 1977; ⁵ Gale et al. 1978.

Table 2. A comparison of avifaunal diversity and diurnal raptor diversity in 6 countries in the neotropics.

COUNTRY	TOTAL KNOWN AVIFAUNAL COMPONENT (TKAC)	TOTAL NO. OF SPECIES OF DIURNAL RAPTORS (TNDR)	% TNDR/TKAC
Mexico ¹	1018	58	5.70%
Guatemala ²	714	49	6.86%
Costa Rica ³	820	53	6.46%
Panama ⁴	883	55	6.23%
Colombia ⁵	1695	75	4.42%
Peru ⁶	1689	71	4.20%

References: ¹ Peterson and Chalif 1973; ² Land 1970; Vannini unpubl. ms.; ³ Stiles 1983; ⁴ Ridgely 1976; ⁵ Hilty and Brown 1986, ⁶ Parker et al. 1982.

are the rule for many taxa. Similarly, Janzen (1986) discussed the importance of corridor-linked premontane habitats in Cordillera de Tilarán with dry forest lowlands of Guanacaste National Park in preserving diversity. Thus El Faro and La Selva, while small reserves, benefit from the pristine "sanctuary areas" which lie above, namely Volcan Santa Maria and the Cordillera Central, respectively. Tikal and Monteverde are convenient "tourist" parks, selected with criteria different from those prevalent at Faro, La Selva or Pipeline Road. That Tikal and Monteverde are also larger and more interesting to the lay visitor has *no* bearing on species diversity, a fact which should not be lost on organizations with an interest in wildlands and wildlife preservation in Central America.

Why Faro possesses such a diverse diurnal raptor fauna remains poorly understood. While elevational range on the farm and the biogeography of the western highlands points towards diversity, conventional wisdom regarding agricultural transformation in the Neotropics and subsequent impacts on wildlife point towards a depauperate fauna. Assumptions based on conventional wisdom would imply that Faro has no value as a reserve.

While we have no way of knowing what original vertebrate densities were in plantation areas, I suspect that the actual situation does not mirror pristine habitat. Although a number of environmentally sensitive vertebrates maintain breeding populations (*Pharomachrus mocinno*, *Crax rubra*, *Vampyrus spectrum*, *Plectrohyla avia*, etc.) numbers may be far lower than original densities. Undoubtedly, other taxa, including many diurnal raptors, have benefitted from agricultural transformation while others have maintained stable populations. As early as 1932, Griscom noted that the avifaunal component of mature coffee

plantations on Guatemala's Pacific versant differed little, if at all, from that of adjacent forest. Many raptors may be able to maintain viable breeding populations in areas which have suffered degradation, yet offer active protection to both prey and predator. Craighead and Craighead (1956) stated that raptor populations are related to vulnerability of prey, rather than prey densities in a given area. Successionary vegetation undoubtedly increases prey vulnerability and coupled with high densities of a highly diverse prey base may account for diurnal raptor diversity at El Faro.

I conclude that a bias by researchers towards work in mature, lowland forests in Central America results in an assumption that environmentally sensitive vertebrates, including many diurnal raptors, can exist only as associates of pristine habitat. I predict that more research in plantations and otherwise modified habitats in the northern Neotropics will reveal a greater degree of adaptability in many diurnal raptor species than has previously been suspected.

SUMMARY

Observations at Finca El Faro have revealed the presence of 4 diurnal raptor species not previously recorded from the western highlands of Guatemala, 2 species not previously recorded from Guatemala's Pacific versant and 1 elevational record (Land 1970). It is unlikely that these distributional records represent local displacement; there are large tracts of pristine premontane forest within 8 km airline of El Faro. Due to the nature of the faunal inventory, no attempt was made to seek nests, but courtship displays and juvenile birds observed suggest that further investigation will reveal nesting diurnal raptors.

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